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IN THE NAME OF

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ASSIGNED TO

ADVANCED MEDICAL OPTICS, INC.

FOR

CANNULA LOCKING DEVICE

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CANNULA LOCKING DEVICE

FIELD OF THE INVENTION

The present invention relates to syringes. In particular, the invention relates to a means for securing a cannula assembly to a syringe body. Such securing means is particularly useful, for example, when such syringe is used with viscoelastic agents in ophthalmic surgery.

BACKGROUND OF THE INVENTION

The term viscosurgery refers to the use of viscoelastic substances in surgery. Ophthalmic viscosurgery encompasses a broad range of intraocular surgical procedures including, for example, cataract surgery, cornea surgery, glaucoma surgery, vitreous surgery, trauma surgery, intraocular lens implantation and retinal detachment surgery. Ophthalmic viscosurgical procedures frequently involve forming an incision in the cornea and subsequently gaining instrument access to one or all of the anterior chamber, lens capsular bag and posterior chamber for the purpose of manipulating target eye structures.

During ophthalmic viscosurgery, viscoelastic solutions are often introduced into the eye to protect tissues and to ease both the introduction of instruments into the surgical field and the concomitant manipulation of eye tissues. Some of the tasks performed by viscoelastics during ophthalmic surgery include lubrication, the coating of surfaces, the creation and maintenance of eye chamber spaces, the separation of tissues, the displacement of mobile tissue, the blocking of outflow ocular fluids, the confinement of bleeding, the exclusion of inflammatory materials and the dampening of instrument movement in the eye.

Cataract surgery is a routine ophthalmic viscosurgical procedure. The procedure can be divided into several steps. Following pupil dilation and local anesthesia, an incision is made through the cornea into the anterior chamber of the eye. Once the anterior chamber is punctured,

the natural aqueous humor leaks out and the chamber loses its characteristic shape and depth. A viscoelastic product is then introduced into the anterior chamber so that the chamber regains its former volume and so that vulnerable tissues such as the corneal endothelium are protected. Next, a capsulotomy is performed, which involves making a hole in the anterior portion of the lens capsular bag. Extraction of the lens itself is then most often accomplished by phacoemulsification (disintegration of the lens by ultrasound, followed by aspiration of the resultant lens particles) or by extracapsular cataract extraction (removal of the lens in one piece). At this stage, a viscoelastic product is again needed to maintain the natural volume of the capsular bag and to facilitate the introduction of a synthetic lens. Upon completion of the surgery, the viscoelastic compound is removed from the eye and replaced with a physiologically compatible salt solution. Generally, viscoelastics cannot be left in the eye due to the compounds' viscosity and the eye's resultant inability to process the compounds through its filtering system. Leftover viscoelastics that cannot be adequately processed by the eye cause a detrimental increase in intraocular pressure.

Viscoelastics are solutions that have viscous, elastic and pseudoplastic properties. Viscoelastics, by definition, have dual properties. They act as both viscous liquids and as elastic solids or gels. The typical viscoelastic is an aqueous solution containing a polysaccharide such as sodium hyaluronate, chondroitin sulfate or hydroxypropylmethylcellulose. Concentrations of viscoelastics vary from 10-70 mg/ml and molecular masses (expressed as mass average relative molecular masses) vary from 20,000 daltons (chondroitin sulfate) to 5,000,000 (sodium hyaluronate).

There are two main classes of viscoelastic compounds: dispersive and cohesive. Viscoat™ (Alcon Laboratories, Inc., Forth Worth, TX) is an example of a dispersive compound

while Healon™ (Pharmacia, Inc., Piscataway, N.J.) is an example of a cohesive compound. Dispersive products are typically high concentration (20 mg/ml to 70 mg/mL) solutions of low molecular weight (less than 500,000 daltons) polysaccharides. Cohesive products are typically low concentration (10-20 mg/mL) solutions of high molecular weight (1 to 5 million daltons) polysaccharides.

During an ophthalmic viscosurgical procedure such as cataract surgery, viscoelastics are typically introduced into the eye through a relatively narrow-gauge cannula coupled to a syringe. The small cannula size is preferred because of the need to use instruments of the smallest possible size when operating in the eye. However, use of a small cannula presents two related difficulties, both stemming from the high viscosity of the most commonly used viscoelastics. First, it is difficult for the operator of the syringe to generate sufficient force to extrude the viscoelastic solution from the syringe into the cannula and, ultimately, out of the cannula. Second, and importantly for present purposes, the pressure built up at the syringe/cannula junction during extrusion of the viscoelastic solution can be exceedingly high, potentially resulting in the cannula becoming disconnected from the syringe.

Commonly assigned U.S. Patent Nos. 5,419,775 and 5,554,133 to Haffner et al. disclose a syringe apparatus that allows the operator to generate sufficient force to extrude a viscoelastic solution. Disclosed in the Haffner patents is an adapter that attaches to a syringe body and provides an operator with an enlarged grip. The enlarged grip allows the operator to depress a plunger of the syringe with a greater degree of opposing force between the operator's thumb and forefinger than would be possible in the case of a conventional syringe apparatus.

However, the difficulty presented by excess pressure at the syringe/cannula junction has been more difficult to solve. Although it may serve to ameliorate the excess pressure, employing

a cannula with a larger diameter is undesirable for ophthalmic applications for the reasons stated above. Thus, various attempts have been made to provide a backup to the conventional Luer lock fitting that is commonly used to couple a cannula to a syringe.

U.S. Patent No. 5,925,032 to Clements discloses a syringe assembly comprising a syringe body, a cannula assembly and a pair of outer sleeve halves. The cannula assembly is disposed upon the syringe body and the sleeve halves are slid over the cannula assembly and subsequently held closed by a retaining nut. It is disclosed that the resulting closed sleeve would restrict the movement of the cannula assembly and prevent the cannula assembly from becoming a projectile inside a patient's eye during surgery, even in the event that the cannula assembly became disconnected from the syringe body.

U.S. Patent No. 5,876,379 to Beauvais et al. discloses a syringe assembly including a sleeve with an open flared end and an end having external and internal threads, a retaining nut with an internal thread designed to engage the external thread of the sleeve, and a cannula assembly having an external thread designed to engage the internal thread of the sleeve. The sleeve is designed to enclose a conventional syringe barrel, whereupon the cannula assembly is threaded onto the sleeve. Finally, the retaining nut is threaded onto the sleeve, thus restricting the movement of the cannula in the event that it becomes disconnected from the syringe body.

There are several disadvantages to the apparatuses disclosed in both the Clements and Beauvais patents. Both require significant additional components to be added to a conventional syringe assembly, including a sleeve and a retaining nut. The requirement for extra, relatively complex components generally increases the cost of manufacturing and, thus, the cost to the end user. In addition, viscoelastic solutions are commonly shipped to practitioners in pre-filled syringe apparatuses that are not fully assembled. Typically, the syringe body and cannula

assembly are not yet joined and the end of the syringe body that is designed to accommodate the cannula assembly is plugged by some form of rubber stopper. Before use during ophthalmic surgery, the doctor or nurse must remove the stopper, attach the cannula assembly to the syringe body and, in the case of the Clements and Beauvais apparatuses, attach the sleeve and retaining nut to complete the syringe apparatus. Standing in direct conflict with the fact that time and simplicity are of the essence during ophthalmic viscosurgical procedures, these extra assembly steps may be time consuming and complex. Extra assembly steps are particularly undesirable from a practitioner's standpoint if additional syringe apparatuses must be assembled during surgery due to unforeseen circumstances that arise during ophthalmic viscosurgery from time to time.

Thus, the prior art does not achieve the most desirable outcome of providing a means for securely fixing a cannula assembly to a syringe body that does not involve excessive manufacturing expense and complexity of operation from the perspective of the end user. The prior art does not suggest a means for securing a cannula assembly to a syringe body that requires only minimal modifications to a commercially available syringe and can be quickly and easily used by a practitioner. Therefore, an inexpensive and easily used means for preventing harmful disconnections of cannula assemblies from syringe bodies is desired.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a perspective view of a cannula locking device according to an embodiment of the present invention.

Fig. 2 shows a perspective view of a partially assembled single compartment syringe, according to an embodiment of the present invention.

Fig. 3 shows a partial axial sectional view of a single compartment syringe with a cannula attached, according to an embodiment of the present invention.

Fig. 4 shows an axial sectional view of a single compartment syringe, according to an embodiment of the present invention.

Fig. 5 shows an axial sectional view of an adapter for a single compartment syringe, according to an embodiment of the present invention.

Fig. 6 shows a perspective view of a cannula locking device of the present invention attached to single compartment syringe assembly, according to an embodiment of the present invention. In the areas of overlap between the cannula locking device and syringe assembly, the cannula locking device is drawn in sectional form.

Fig. 7 shows a perspective view of a bi-compartment syringe, according to an embodiment of the present invention.

Fig. 8 shows a perspective view of a cannula locking device of the present invention attached to a bi-compartment syringe assembly, according to an embodiment of the present invention. In the areas of overlap between the cannula locking device and bi-compartment syringe assembly, the cannula locking device is drawn in sectional form.

DETAILED DESCRIPTION OF THE INVENTION

It has been discovered that a cannula assembly can best be secured to a syringe body through the use of a cannula hood according to the present invention. According to an embodiment of the present invention, the cannula hood may form a lumen and may form openings at its proximal and distal ends. Additionally, the cannula hood may comprise a cylindrical portion closest to its proximal end and a tapered portion closest to its distal end. The tapered portion may comprise a proximal section, a mid section and a distal section. The

cylindrical portion may be designed to fit over the syringe body and the tapered portion may be designed to narrow at its apex to provide an opening that accommodates the diameter of a needle portion of the cannula assembly.

The cannula hood may be constructed of plastic or rubber materials such as, but not in any way limited to, silicone, latex-free rubber, soft PVC, polycarbonate or acrylic. The cannula hood may be uniform in its construction or, in the alternative, the cylindrical portion may be constructed of a softer material and the tapered portion may be constructed of a firmer material. By way of example only, the cylindrical portion may be constructed of silicone and the tapered portion may be constructed of PVC.

The cannula hood may adapt a conventional syringe apparatus designed for ophthalmic viscosurgery in a relatively simple and cost-effective manner that prevents dangerous disconnections of cannula assemblies from syringe bodies. Accordingly, a commercially available syringe body may be purchased along with a commercially available cannula assembly. The syringe body may be pre-filled with a viscoelastic solution and the pre-filled syringe body may be shipped to an end user along with the cannula assembly and a cannula hood according to the present invention. The end user, typically a doctor or nurse, may attach the cannula assembly to the syringe body at a conventional Luer lock fitting and then may slide the cannula hood over the needle portion of the cannula assembly and fix the cannula hood to the syringe body by way of a friction fit. One skilled in the art will realize that alternate means of attaching the cannula hood to the syringe are possible including, but not in any way limited to, clipping the cylindrical portion of the cannula hood to a Luer lock mechanism of a conventional syringe apparatus. One skilled in the art will also realize that the cannula hood of the present invention may be used with any commercially available filled or empty syringe body.

The cannula assembly may include a hub portion that facilitates coupling of the cannula assembly to the syringe body. The cannula hood may be designed such that the proximal section of the tapered portion has a diameter greater than the diameter of the hub portion, the mid section of the tapered portion has a diameter that is equal to the diameter of the hub portion and the distal section of the tapered portion has a diameter that is less than the diameter of the hub portion. If the cannula assembly were to become disconnected from the syringe body during a viscosurgical procedure, the hub portion of the cannula assembly would make contact with the tapered portion of the cannula hood and would be prevented from moving in a distal direction to a point beyond the mid section of the tapered portion of the cannula hood. The cannula assembly would therefore be prevented from making excessive movement towards the distal end of the cannula hood and, thus, would not become a projectile in the surgical field. Therefore, harmful disconnection of the cannula assembly from the syringe body would be prevented and damage to tissues in the surgical field would be ameliorated.

The cannula hood of the present invention may be attached to conventional single compartment syringe assemblies or to multi-compartment syringe assemblies. Various embodiments of the cannula hood of the present invention may also be designed in a multitude of sizes so as to accommodate syringe bodies and cannula assemblies of various sizes.

The cannula hood of the present invention has significant advantages over prior art devices for preventing harmful disconnections of cannula assemblies from syringe bodies. The present cannula hood employs a simple design and is constructed of common, inexpensive materials. Thus, manufacturing costs and corresponding end user costs will be lower than those associated with the prior art devices. In addition, the cannula hood disclosed herein can be used as a simple modification to commercially available syringes. Prior art devices require more

extensive modifications to commercially available syringes, including the addition of sleeves and retaining nuts. The minimal modifications associated with the cannula hood of the present invention produce a lower cost device that is simple to use. Rather than going through several steps to attach an external sleeve to a syringe body with a retaining nut, a practitioner is able to slide the cannula hood onto the syringe body, where it is retained by a friction fit. Ease of use is a key advantage of the cannula hood of the present invention since speed and simplicity are of the essence in the context of ophthalmic viscosurgical procedures.

In the embodiment of the present invention shown in Figure 1, the cannula hood **1** may form a lumen **2** and may form openings at its proximal **3** and distal **4** ends. Additionally, the cannula hood **1** may comprise a cylindrical portion **5** closest to its proximal end **3** and a tapered portion **6** closest to its distal end **4**. The tapered portion **6** may comprise a proximal section **9**, a mid section **10** and a distal section **12**. The cylindrical portion **5** may be designed to fit over a syringe body and the tapered portion **6** may be designed to narrow at its apex **7** to provide an opening **8** that accommodates the diameter of a needle portion of a cannula assembly.

The cannula assembly may include a hub portion that facilitates coupling of the cannula assembly to the syringe body. The cannula hood **1** may be designed such that the proximal section **9** of the tapered portion **6** has a diameter greater than the diameter of the hub portion, the mid section **10** of the tapered portion **6** has a diameter that is equal to the diameter of the hub portion and the distal section **12** of the tapered portion **6** has a diameter that is less than the diameter of the hub portion. Thus, if the cannula assembly were to become disconnected from the syringe body during a viscosurgical procedure, the hub portion of the cannula assembly would make contact with the mid section **10** of the tapered portion **6** of the cannula hood **1**. The cannula assembly would therefore be prevented from excessive movement towards the distal end

4 of the cannula hood 1 and, thus, would not become a projectile in the surgical field. Therefore, harmful disconnection of the cannula assembly from the syringe body would be prevented and damage to tissues in the surgical field would be ameliorated. Preferably, the tapered portion 6 may be designed to narrow in its diameter towards the distal end 4 of the cannula hood 1 such that, upon disconnection of the cannula assembly from the syringe body, movement of the cannula assembly towards the distal end 4 of the cannula hood 1 is largely or completely prevented. One skilled in the art will realize that this goal may be achieved by designing the tapered portion 6 such that the mid section 10 of the tapered portion 6 will be positioned immediately distal to the hub portion of the cannula assembly when the cannula hood 1 is attached to the syringe body.

The tapered portion 6 of the cannula hood 1 may be designed in the shape of a cone. The tapered portion 6 may also be designed such that its diameter narrows in a step-wise fashion when viewed from a proximal to distal direction. One skilled in the art will realize that many other tapered designs are possible and are encompassed by the description herein.

The cannula hood 1 may be constructed of plastic or rubber materials such as, but not in any way limited to, silicone, latex-free rubber, soft PVC, polycarbonate or acrylic. In one embodiment, the entirety of the cannula hood 1 may be constructed of a single material. In an alternative embodiment, the cylindrical portion 5 of the cannula hood 1 may be constructed of a softer material and the tapered portion 6 may be constructed of a firmer material. By way of example only, the cylindrical portion 5 may be constructed of silicone and the tapered portion 6 may be constructed of PVC. The cannula hood 1 may be constructed by injection molding or other means commonly known in the art. In an embodiment wherein the cannula hood 1 is constructed entirely of one material, a one-shot injection molding process may be used, although

any other means of construction commonly known in the art may also be used. In an embodiment wherein the cannula hood **1** is constructed of two materials, a two-shot injection molding process may be used, although any other means of construction commonly known in the art may also be used.

The cylindrical portion **5** of the cannula hood **1** may preferably be designed to form a friction fit with a syringe body. Other attachment means of the cannula hood **1** to the syringe body are possible, including, but not in any way limited to, adhesives and retaining devices. By way of example only, the proximal end **3** of the cylindrical portion **5** of the cannula hood **1** may be clipped onto a proximal end of a conventional Luer lock mechanism of a conventional syringe body. The cylindrical portion **5** of the cannula hood **1** may be designed in varying diameters so as to accommodate syringe bodies of varying diameters. The tapered portion **6** of the cannula hood **1** may narrow at its apex **7** to form an opening **8** that snugly or loosely accommodates the needle portion of a cannula assembly. The opening **8** may be designed with varying diameters so as to accommodate needles of varying diameters. When the tapered portion **6** of the cannula is formed of a softer material, it may flex to accommodate needles of varying diameters.

The cannula hood may adapt a single compartment syringe **11** such as, but not in any way limited to, that depicted in Figure 2. The syringe **11** comprises a barrel **13**, a plunger **15**, an adapter **17**, a connector in the form of a Luer lock fitting **19** and a tip cap **21**. The syringe **11** may also be considered as including a cannula **23** (Figure 3). The cannula **23** depicted in Figure 3 has a small diameter passage **24** which may be, for example, about 0.008 inch to about 0.020 inch in diameter. The cannula **23** also has a hub **22**, which is adapted for connection to the Luer lock fitting **19**.

The barrel **13** may be of a common commercially available type which includes a

cylindrical, longitudinal passage **25** extending through the barrel **13**, and a circular flange **27** at the proximal end of the barrel **13**. The distal end of the barrel **13** has an axially extending tip section **29** which is adapted for connection to the Luer lock fitting **19**. The tip section **29** has an axial bore **30** extending through the tip section. Except for the flange **27** and the tip section **29**, the barrel **13** is cylindrical. The barrel **13** is preferably integrally constructed of glass. The barrel **13** may alternatively be constructed of any material known in the art including, but not in any way limited to, plastic.

The Luer lock fitting **19** is also conventional and commercially available. As such, it includes an internally threaded socket **31** (Figure 4) and an aperture **33** in its back wall for receiving the tip section **29** to which it is suitably attached as a mechanical interlock commonly used for Luer lock fittings. The Luer lock fitting **19** may also be constructed of polycarbonate.

The tip cap **21** is also a commercially available component and is provided for the purpose of sealing off the bore **30** in the tip section **29** to maintain sterility within the passage **25**. The tip cap **21** is constructed of an elastomeric material and it includes an annular sealing skirt **35** and a knob **37** for use in installing and removing the tip cap.

The plunger **15** includes an elongated shank **39** which, in this embodiment has a plus or cross-shaped cross section and a pressure pad **41** at the proximal end of the shank **39**. The plunger **15** may also be considered as including a conventional resilient piston **43** coupled to the distal end of the shank **39** and cooperable with the passage **25** to provide a pumping type function common to syringes. Thus, by moving the plunger **15** proximally, the piston **43** can draw a flowable material **44** into the passage **25** and by moving the plunger distally, the flowable material can be expelled from the passage **25** through the cannula **23** (Figure 3). The pressure pad **41** is relatively large and may be, for example, about 0.74 inch in diameter. Although the

plunger **15** may be constructed of various different materials, polycarbonate is preferred.

The adapter **17**, which may also be constructed of polycarbonate, includes a resilient section **45** and a collar **47** which extends radially outwardly to form finger pads **49** on opposite sides of the adapter **17**. More specifically, the finger pads **49** are simply diametrically opposed portions of an annular surface **51** which surrounds the resilient section **45**.

The adapter **17** also includes a bore or passage **53** extending axially completely through the adapter and a counterbore **55** of circular configuration sized and adapted to receive the flange **27**. Although the resilient section **45** may be of various different constructions, in this embodiment it includes a plurality of resilient spring fingers **57** which are spaced circumferentially by axially extending slots **59**. As shown in Figure 5, the fingers **57** taper such that they become progressively thinner in their radial dimension as they extend distally.

As shown in Figure 4, the passage **53** through the adapter **17** is adapted to receive the barrel **13** to mount the adapter **17** on the barrel **13**. The adapter **17** can be positioned in engagement with the flange **27** of the barrel **13** with the counterbore **55** receiving the flange **27** as shown in Figure 4. In this position, the adapter **17** extends radially beyond the flange **27** to provide the finger pads **49** which can be engaged by the index and middle fingers of the user when the thumb of the user presses on the thumb pad **41**.

The resilient fingers **57** perform several important functions. For example, the adapter **17** can be assembled onto the barrel **13** by pushing the adapter over the tip cap **21** and the Luer lock fitting **19**. In this regard, the Luer lock fitting **19** may be, and typically is, larger radially than the barrel **13**. However, as clearly shown in Figures 2 and 4, the fitting **19** is not larger radially than the flange **27** and so more specifically the fitting **19** is larger radially than a main body portion of the barrel **13** which may include all of the barrel **13** except the flange **27**. In this event, the

resilient fingers **57** resiliently flex radially outwardly to allow the adapter to slide over the fitting **19** to mount the adapter on the barrel **13**.

Once in position on the barrel **13**, the fingers **57** resiliently grip the barrel to frictionally retard sliding movement of the adapter **17** along the barrel **13**. In addition, the fingers **57** are engageable with the fitting **19** to positively resist sliding of the adapter **17** off of the connector **19**.

Although the syringe **11** may be used with a variety of flowable materials **44**, it is particularly adapted to be used with a sodium hyaluronate based material such as a sodium hyaluronate solution sold under the trademark Vitrax by Advanced Medical Optics, Inc. of Santa Ana, CA. This material is injected into the posterior capsule of the eye during ophthalmic surgery in which the natural lens of the eye is being removed. Consequently, the syringe **11** may be sold with the passage **25** filled with the material **44** which may be a viscous flowable liquid, such as Vitrax or another hyaluronate based material.

Because the syringe is to be used in a medical context, it must be sterilized. Such sterilization is typically carried out using ethylene oxide gas. With the adapter **17** receiving the flange **27** in the counterbore **55**, it is important to provide a flow path for sterilization gas to flow to the flange **27**. Although this could be accomplished in different ways, in this embodiment, the flow path is provided by the slots **59** between the resilient fingers **57** and by mounting the collar **47** on the barrel **13** in a non-sealing relationship so that the sterilization gas can pass through the slots **59** and the unsealed interface between the collar **47** and the barrel **13**.

In use of the syringe **11**, the tip cap **21** is removed from the fitting **19** and the cannula **23** is attached to the fitting **19**. The material **61** in the passage **25** can then be expelled through the small diameter passage **24** in the cannula **23** by moving the plunger **15** distally in a conventional

manner. The larger area provided by the finger pads **49** and the pressure pad **41** facilitates the manual application of significant force to the plunger **15**. Consequently, the plunger can be advanced to bring about movement or extrusion of the viscous material **61** through the small diameter passage **24** of the cannula **23**.

The cannula hood **1** may adapt the single compartment syringe **11** depicted in Figures 2-5 by sliding over the cannula **23** and forming a friction fit between the cylindrical portion **5** and the fitting **19**. In the alternative, and as depicted in Figure 6, the cannula hood **1** may be slid further in the proximal direction such that a friction fit is formed between the cylindrical portion **5** and the barrel **13**. The cannula hood **1** may be designed such that the proximal section **9** of the tapered portion **6** has a diameter greater than the diameter of the hub portion **22**, the mid section **10** of the tapered portion **6** has a diameter that is equal to the diameter of the hub portion **22** and the distal section **12** of the tapered portion **6** has a diameter that is less than the diameter of the hub portion **22**. Thus, if the cannula **23** were to become disconnected from the syringe **11** during a viscosurgical procedure, the hub portion **22** of the cannula **23** would make contact with the mid section **10** of the tapered portion **6** of the cannula hood **1**. The cannula **23** would therefore be prevented from excessive movement towards the distal end **4** of the cannula hood **1** and, thus, would not become a projectile in the surgical field. Therefore, harmful disconnection of the cannula **23** from the syringe **11** would be prevented and damage to tissues in the surgical field would be ameliorated.

The cannula hood **1** may also adapt a bi-compartment syringe **101** such as, but not in any way limited to, that depicted in Figure 7. Bi-compartment syringes adapted by the cannula hood **1** of the present invention may be largely similar in construction to the single compartment

syringe **11** depicted in Figures 2-5, except for the addition of a second compartment that may contain an additional viscoelastic solution.

With reference to the bi-compartment syringe **101** depicted in Figure 7, viscoelastic solutions are contained in separate compartments of the bi-compartment syringe **101** that are situated above each other, enclosed by a common housing **110**. The compartments are optimally separated by a membrane or separation member **104**. In this embodiment, the distal end of the bi-compartment syringe **101** may be a cannula **106** having a distal blunt end **107** that is external to the syringe body and a proximal sharp end **108** that is internal to the syringe body. Initially, the proximal sharp end **108** of the cannula **106** that is adjacent to the first viscoelastic solution **102** may be in fluid contact with the first viscoelastic solution **102** or may be separated from said first viscoelastic solution **102** by a membrane or other device. To dispense the first viscoelastic solution **102**, the user applies pressure to a plunger **105** at the proximal end of the bi-compartment syringe **101**. Said applied pressure forces the separation member **104** downward by fluid pressure, thus forcing the first viscoelastic solution **102** through the sharp proximal end **108** of the cannula **106** and expelling the first viscoelastic solution **102** from the distal blunt end **107** of the cannula **106**. Upon application of additional pressure, the separation member **104** comes into contact with the sharp proximal end **108** of the cannula **106** and is then pierced. At this point, the cannula **106** is in fluid contact with the second viscoelastic solution **103**. Continued pressure on the aforementioned plunger **105** serves to force the second viscoelastic solution **103** through the sharp proximal end **108** of the cannula **106** and expel the second viscoelastic solution **103** from the distal blunt end **107** of the cannula **106**. One skilled in the art will realize that the cannula hood **1** of the present invention may also adapt a bi-compartment

syringe wherein the compartments are arranged in a side-by-side design, rather than being arranged one on top of the other as described above.

As shown in Figure 8, the cannula hood **1** may adapt the bi-compartment syringe **101** depicted in Figure 7 by sliding over the cannula **106** and forming a friction fit between the cylindrical portion **5** and the housing **110**. The cannula hood **1** may be designed such that the proximal section **9** of the tapered portion **6** has a diameter greater than the diameter of a hub portion of the cannula **106**, the mid section **10** of the tapered portion **6** has a diameter that is equal to the diameter of the hub portion and the distal section **12** of the tapered portion **6** has a diameter that is less than the diameter of the hub portion. Thus, if the cannula **106** were to become disconnected from the syringe **101** during a viscosurgical procedure, the hub portion of the cannula **106** would make contact with the mid section **10** of the tapered portion **6** of the cannula hood **1**. The cannula **106** would therefore be prevented from excessive movement towards the distal end **4** of the cannula hood **1** and, thus, would not become a projectile in the surgical field. Therefore, harmful disconnection of the cannula **106** from the syringe **101** would be prevented and damage to tissues in the surgical field would be ameliorated. One skilled in the art will realize that other multi-compartment devices, including those known in the art, may be used to separately introduce multiple viscoelastic solutions into the eye for concurrent use during ophthalmic surgery. Thus, one skilled in the art will realize that all such multi-compartment devices may be adapted by the cannula hood **1** of the present invention.

While the description above refers to particular embodiments of the present invention, it should be readily apparent to people of ordinary skill in the art that a number of modifications may be made without departing from the spirit thereof. The accompanying claims are intended to encompass such modifications as would fall within the true spirit and scope of the invention.

The presently disclosed embodiments are, therefore, to be considered in all respects as illustrative and not restrictive. Accordingly, the scope of the invention is indicated by the appended claims rather than the foregoing description. All changes that come within the meaning and range of equivalency of the claims are intended to be embraced therein.